A history of fertility data collection and estimation in Zambia

Kambidima Wotela

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Kambidima Wotela[1]

Abstract

This paper summarises several reports and articles on Zambian fertility to provide a historical context of fertility estimation in Zambia. Most importantly, it provides pointers to important reference materials on Zambian fertility for purposes of understanding the available demographic data sets. The article serves as a starting point for those wishing to study Zambian demography since temptations to do so are high among researchers because demographic data for several countries are readily available through programmes such as the DHS and IPUMS.

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1 Introduction

This paper presents Zambian national fertility estimates from 1950 to 2007 published in census and survey reports. The paper begins by reviewing data sources used for fertility estimation before and after Zambia's political independence and the problems associated with measuring fertility. The review shows that Zambia's fertility data source, quality and estimation issues are common to other developing countries. The official estimates show that Zambian fertility is high (still over five children per woman) and its transition to low fertility has been sluggish. There is a need to understand why fertility in Zambia has remained perpetually high.

2 A history of data collection in Zambia from 1900

Before Zambia's political independence, the British colonial government did not undertake a direct count of the black-Zambian population. Instead, they estimated the Zambian African population using annual tax returns and administrative information (Kuczynski 1949; Stone 1990). The Native Tax Ordinance of 1901 required each household head to state the number of wives and children yearly (Musambachime 1990). For absent subjects, village chiefs provided this information on their behalf. The colonial government sent these statistics to the British Colonial Administration Office for publication in the Annual Report on African Affairs (Brelsford 1965). However, these statistics were limited mainly because administrators had no incentive to count women and children accurately since the main interest of the 1901 Native Tax Ordinance was tax-paying adult-males.

Besides its limited content, colonial administrative information on the black-Zambians is incomplete and lack a consistent periodicity (Musambachime 1990; Stone 1990). First, these data are incomplete because of migrations and the conscious failure of some adult males to register in order to avoid paying tax (Kuczynski 1949). Second, administrators could only collect accurate information when it was convenient to do so—for example, during periods (or in areas) free of sleeping sickness, smallpox and Spanish influenza (Musambachime 1990). It is, therefore, almost impossible to stratify the population by age and sex from these data—thus making it impossible to estimate fertility from the age distribution (Kuczynski 1949).

Using the 1908 and the 1914 Native Authority Ordinance, the colonial government tried but unsuccessfully to collect birth and death statistics (Kuczynski 1949). By 1930, coverage of birth and death statistics for black-Zambians' was a mere

three per cent because the 1908 and 1914 legislature had made birth and death registration optional. This compelled the administrators to make registration compulsory in 1930 (Kuczynski 1949). However, despite changing legislature, administrative costs inhibited coverage of birth and death registration to all villages. To cut cost but improve coverage, the colonial government introduced the Notification of the Births of the Children of Africans Ordinance in 1939, which placed onus on parents to report any births in their households. Even this law did not improve coverage because individuals did not have any incentive to report births. Overall, as Kuczynski (1949: 515) observes, during the colonial period "… all available population figures are untrustworthy …". Therefore, he cautions that "… all opinions on fertility, morbidity, mortality and population growth are based on impressions rather than facts" (Kuczynski 1949: 517). Even after independence in 1964, the completeness of continuous registration of births in Zambia has remained unsatisfactory. In 1985, twelve years after the Zambian government passed the Birth and Death Registration Act in 1973, birth registration was still below 15 per cent of the number of births (Central Statistical Office [Zambia] 1985b).

Therefore, in line with most sub-Saharan African countries, censuses and demographic sample surveys are the main source of data for demographic studies on Zambia. Censuses provide information on demographic and socio-economic parameters—such as size, age and sex composition, births and deaths—on the *entire* population of a defined region at a specific time (Bryan 2004). Census information is useful for socio-economic planning as well as evaluation of demographic parameters from one census to another for purposes of altering incumbent development plans accordingly (Cleland 1996). Similarly, demographic sample surveys—such as the Demographic and Health Survey (DHS)—provide *detailed* information on demographic and socio-economic parameters of a *fraction* of a population of a defined region at a specific time (Bryan 2004). Sampling of large or national surveys is usually proportionate to population size or representative—therefore, information collected in such surveys should match that collected in the census for a sub-population with a similar profile. More importantly, demographic sample surveys collect more information on the proximate and underlying determinants of demographic parameters—such as full pregnancy and marriage histories, contraceptive use and reproductive health (Cleland 1996).

Compared with the census, preparations and implementation of the DHSs are superior and usually result in more complete and correct data (Cleland 1996). The team of fieldworkers in the DHS is smaller. This provides for intensive training and easy supervision during data collection. The sex of fieldworkers used to canvass is the same as respondents. As a result, female respondents are more comfortable discussing sex and reproductive health issues with female-nurse enumerators than male interviewers (Central Statistical Office [Zambia], Central Board of Health [Zambia] and ORC Macro 2003). The DHS does not use proxy respondents. Lastly, the DHS collects detailed data, for example, birth histories. They use these data to check and correct for internal consistency (Rutstein and Rojas 2003; Pullum 2004). However, DHSs are prone to sampling errors and sometimes the small sample size limits the extent to which the data can provide subnational demographic estimates. There is, therefore, a possibility that differences in data quality and sampling errors may balance out disparities, if any, of census and DHS estimates.

Between 1900 and 2008, the Zambian authorities have conducted ten censuses and seven major demographic surveys—apart from smaller and limited purpose-specific surveys (often unpublished). Despite this seeming plentiful data, it is not possible to establish Zambia's demographic trends before the 1950s as the first six censuses (those conducted between 1911 and 1961 inclusive) did not count the Black-Zambian population other than those employed in the urban areas (Sheikh 1975; Ohadike 1990). The Colonial Government had earmarked to include Black-Zambians in the 1961 Census but "logistical problems[1]" made this impossible (Sheikh 1975).

Lastly, the United Nations (Population Division) and the World Bank also publish demographic estimates for Zambia[2]. The United Nations assembles demographic estimates for each member country from official publications and correspondence (United Nations 1979, 1997). To facilitate comparisons, they recompute these estimates and publish them yearly in the Demographic Yearbook. By contrast, the World Bank gets demographic estimates and related indicators from the United Nations (or its specialised agencies), the United States Bureau of the Census and sometimes official results of member countries (The World Bank 2003). They publish their estimates in the World Development Reports.

[1] Sheikh and other sources do not document the nature of the logistical problems faced by the Colonial Government.

[2] We do not present or discuss, in detail, the United Nations and the World Bank estimates because they are not materially different from those presented in the official reports.

3 Fertility data collection and measurement in Zambian censuses and surveys from 1950 to 2007

The 1950-1951 Demographic Sample Survey (1950-51 DSS)[3] is the earliest documented source of Zambian national and regional fertility estimates (Ohadike 1990). This survey collected information on the number of births during the year preceding the survey to all adult women. From this information, the Central African Statistical Office wanted "to determine…the average annual number of live births per woman over puberty…of the African population" (Sheikh 1975: 2). The term "over puberty" meant women aged from approximately 12 years to beyond 49 years. The CSO (1975) and Sheikh (1975) report that the Central African Statistical Office (Harare) published results of this survey in 1952. However, efforts to obtain a copy of this report have failed[4].

The Colonial Government conducted the first population census covering Africans living in Zambia in 1963 to complement the 1961 non-African Census and to prepare for independence. The CSO (1975), Ohadike and Tesfaghiorghis (1975), Sheikh (1975) and Hill (1985) report that the CSO published the results of this census—in three volumes—between 1964 and 1968. However, efforts to find any of these reports have been unsuccessful. The cited sources, however, report that the 1963 Census did not collect specific information on fertility. Therefore, the CSO officials could only estimate the Crude Birth Rate[5] (CBR) and the Child-Woman Ratio (CWR) from the 1963 Census age-sex distribution. Without providing details, the CSO (1975) notes that fertility estimates from the 1963 Census data are inaccurate because of errors—most probably a distorted age-sex distribution. Coale and Lorimer (1968) report that the age-sex distribution derived from the 1963 Census data was distorted because of age misreporting—that is, an undercount of females and an overstatement of the proportion of males aged below 15 years old. Ohadike (1990) attributes the 1963 Census data errors and poor returns to low educational levels among enumerators.

[3] Coale and Lorimer report a survey that covered the entire country in 1956 but the details of their data sources indicate that they were referring to the 1950-51 DSS.

[4] For this and other reports and documents I could not find, I had made repeated efforts to check the Zambian Central Statistical Office library. I also asked colleagues working for the CSO and other Zambian Government departments, including the archives. I could only find reports and documents published in recent years (after 1980). My suspicion is that reports published before 1980 are in Harare since this is where the Federation Government of Rhodesia and Nyasaland had situated the headquarters of the Central African Statistical Office. Most immediate post-independence reports and documents cited in this article came from the Population Studies Centre (PSC) Library at the University of Michigan.

[5] Using the population under one year old and the total population—and even this is not entirely correct.

The 1969 Census of Population and Housing was the first set out to enumerate the entire population of Zambia and the first national census after Zambia's political independence. It was also the first census to collect information on lifetime (parity, or children ever born) and current fertility. Enumerators asked women of reproductive age—15 years and older (without an upper limit, however) at enumeration—to state the number of children that they had had in their lifetime and the date of their most recent birth (Central Statistical Office [Zambia] 1974). Both the CSO (1973; 1974) and Hill (1985) raise concerns about the quality of the fertility data collected in the 1969 Census. Being the first to collect such, its fertility data returns were inconsistent because of errors. The CSO (1973; 1974) speculate that the inconsistencies arose because of age misreporting and the failure by respondents to locate accurately the date of the "last birth". Hill (1985) observes that the census enumerators misclassified childless women as women with unknown parity. Further, the census returns under-reported births that had occurred in the last one year (Hill 1985).

The second survey, undertaken five years after the 1969 Census was the 1974 Sample Census. The timing of this survey (five years after the 1969 Census) suggests that its objective was to provide intercensal (1969-1979) information—although the CSO conducted the next census after 1969 in 1980. The 1974 Sample Census had an overall sampling fraction of about 14 per cent of the 1969 Zambian population or 655,000 individuals (Hill 1985). Using a separate detailed fertility questionnaire, this sample census collected lifetime and current fertility data from women of reproductive age—12 years and older, without an upper limit (Hill 1985). For current fertility, unlike the 1969 Census, this survey asked women to report the number of children born in the last year or last twelve months before enumeration. Apart from analysis by independent demographers such as Althea Hill and Barney Cohen, the research literature rarely refers to the results from this survey. Efforts to get the official report or the data of this survey have also been unsuccessful.

Since the 1969 Census, the Zambian Government has conducted censuses in 1980, 1990 and 2000 in accordance with the United Nations recommendations. The CSO collects data on lifetime fertility by asking women older than 12 years without an upper limit about the number of live births they have had. There are two main ways of collecting data on current fertility in censuses in place of full maternity or pregnancy histories such as those collected in the DHS. The first requires women of reproductive age to state the date of their last live birth. If the birth date falls within one year (or

some other desired interval) before the data collection exercise, it qualifies for inclusion in current fertility calculations. The second involves asking women the number of children born in the last year or in the last twelve months before the enumeration. The Zambian CSO uses the second question.

Fieldwork for the 1980 Census was held from 15th August to 7th September 1980 (Hill 1985). However, the official census night is 25th July 1980[6] (United States Census Bureau 2008). The CSO abandoned the 1980 Census post-enumeration survey (PES) after fieldwork because it was inadequately planned (Diangamo and Dzekedzeke 2001). Analysis of the 1980 Census data presented by the CSO (1995b) in the 1990 Census report suggest Myers' indices of 7.0 for males and 7.5 for females and the most preferred digits as zero, two and eight. They also report a United Nations age-sex accuracy index of 34.9 that classifies the reliability of the 1980 Census age-sex reports as inaccurate (Central Statistical Office [Zambia] 1995b). Reanalysis of the 1980 Census data presented by the CSO (2003) in the 2000 Census report suggest a worse-off United Nations age-sex accuracy index (39.9)—almost classifying the age-sex reports as highly inaccurate. However, they do not present reasons for the inconsistencies between the two reports.

Data collection for the 1990 Census lasted from 20th August to 5th September 1990—for remote areas, the CSO extended enumeration by a week (Central Statistical Office [Zambia] 1995b). The official census night is 20th August 1990[7] (United Nations 2007). The 1990 Census post-enumeration survey (PES), undertaken by the CSO in December 1990, shows a national undercount of 5.5 per cent (Central Statistical Office [Zambia] 1995a). The distribution of the undercount by age shows that infants and children under five (7.8 per cent), especially males, were the most inadequately captured. Central Province had the lowest undercount (3.1 per cent) while Western Province had the highest undercount (8.0 per cent). The CSO (1995a) ascribes the poor coverage of Western Province to inaccessibility of some areas because the terrain in this province is not suitable for road transport. Poor preparations contributed—for example, the CSO rushed mapping and stratifying this province into Census Supervisory Areas (CSAs) and Standard Enumeration Areas (SEAs).

The United Nations age-sex accuracy index the CSO (1995b) obtained (27.8) classifies the reliability of the 1990 Census age-sex reports as inaccurate. They present

[6] There is a need to verify this date, but efforts to find the *1980 Population and Housing Census of Zambia: Analytical Report Volumes I and II* have proved futile.

[7] However, the CSO define the 1990 Census night as the night before the day of canvassing the household.

Myers' indices of 6.8 for males and 7.0 for females and the most preferred digits as zero, two and eight. The Reanalysis of the 1990 Census data presented by the CSO (2003) in the 2000 Census report suggest Myers' indices of 6.9 for males and 7.1 for females and a worse-off United Nations age-sex accuracy index (31.7). Similarly, they do not present reasons for the inconsistencies between the two reports.

Fieldwork for the 2000 Census lasted a month from 16th October to 15th November 2000 (Central Statistical Office [Zambia] 2003). The official census night is 25th October 2000[8] (United Nations 2007). To reduce insubordination during fieldwork, the CSO hired Grade 11 pupils (roughly 18 years old) as enumerators and schoolteachers as their supervisors unlike previous censuses in which they employed part-time personnel regardless of affiliation (Central Statistical Office [Zambia] 2003). There is no report evaluating the outcome of this strategy. Further, the CSO has not published the report of the 2000 Census post-enumeration survey (PES) they undertook in February 2001 (Diangamo and Dzekedzeke 2001; Central Statistical Office [Zambia] 2003). The CSO (2003) report a United Nations age-sex accuracy index of 28.7, which classifies the reliability of the 2000 Census age-sex reports as inaccurate. They present Myers' indices of 7.3 for both males and females and the most preferred digits as five for males as well as zero and eight for both males and females.

Therefore, despite efforts to improve data collection procedures, age misreporting affecting all respondents compromises the quality of census data. Other than age misreporting, the CSO reports that fertility data collected in censuses are faulty due to inaccurate reporting of births. Omission of births (especially infants dying immediately after birth and among older women) distorted the fertility data collected in the 1980 Census (Central Statistical Office [Zambia] 1985a, 1985b). Similarly, in the 1990 Census, women omitted children that had died, those living elsewhere and those born outside their current sexual unions (Central Statistical Office [Zambia] 1995b). The CSO (2003) also report that lifetime fertility in the 2000 Census was inaccurately reported due to omission of children by older women. Meanwhile, women included stillbirths as well as step, adopted and grand children among their birth reports. Another problem that affected fertility reports was the inability of women to locate accurately whether a birth occurred within the reference period—that is, in the 12 months before the enumeration. The net effect of these errors is under-reported lifetime and current fertility especially among older women. Apart from those presented by the Central

[8] It is different from that—16th October 2000—presented by the CSO . Efforts to get a reason for this revision (trivial as it is) from the Zambian CSO have failed.

Statistical Office, there are no published or documented evaluations of the 1980, 1990 and 2000 Censuses data or their collection procedures. Therefore, it is difficult to ascertain other flaws in the data that could have affected fertility estimation. However, this alerts us that we should take caution when interpreting estimates computed from these sources.

The third source—among the sample surveys—is the series of surveys conducted under the Demographic and Health Survey (DHS) Programme. So far, various Zambian institutions with technical and funding support from Macro International Inc have undertaken four DHSs in Zambia; in 1992, 1996, 2001-2002 and 2007. DHSs provide detailed information on fertility, child mortality and reproductive health of a sample of the Zambian population comprising mostly women of reproductive age. Unlike the census, the DHS collects full birth history data, thereby, allowing estimation of both current and (albeit increasingly censored) retrospective fertility.

The first two Zambia DHSs employed a three-stage sample selection based on the 1990 Census Supervisory Areas (CSAs) and Standard Enumeration Areas (SEAs) stratified into urban and rural residence (University of Zambia, Central Statistical Office [Zambia] and Macro International Inc 1993; Central Statistical Office [Zambia], Central Board of Health [Zambia] and ORC Macro 1997). Similarly, the 2001-02 and the 2007 Zambia DHS employed the same sampling strategy but used the 2000 Census sampling frame (Central Statistical Office [Zambia], Central Board of Health [Zambia] and ORC Macro 2003; Central Statistical Office [Zambia], Ministry of Health [Zambia], Tropical Diseases Research Centre [Zambia] *et al.* 2009). In all four DHSs, provinces with smaller population sizes were over-sampled to get a minimum number of individuals deemed necessary to estimate regional parameters. As a result, the Zambia DHS samples are not self-weighting at national level. Sample weights that the DHS provide with the data make the sampled population representative of that on which the sample frame was based.

The fieldwork for the 1992 DHS was carried out from 18th January to 15th May 1992 (almost 4 months) while that for the 1996 DHS was conducted for almost five months (15th July 1996 to 6th January 1997). The 2001-02 ZDHS and the 2007 ZDHS lasted even longer—almost seven months (8th November 2001 to 3rd June 2002) and

about six months (1st April to 7th October 2007), respectively. The mean survey dates[9] are respectively 22nd March 1992, 17th October 1996, 4th March 2002 and 10th July 2007.

Ideally, fertility estimates derived from the 1990 and 2000 Censuses should be similar to those derived from 1992 and 2001-02 DHSs, respectively because the 1990/2000 Census and the 1992/2001-02 DHS estimates refer to roughly the same reference period. The reference dates for fertility estimates derived from the 1990 and 2000 Censuses are, on average, six months before enumeration—that is, *February 1990* and *April 2000*, respectively. The reference dates for the DHS estimates are 18 months before the survey since they are based on births reported in the three years before the survey. Using the mean survey dates as the enumeration dates, the reference dates for the four Zambia DHSs are *September 1990* (1992 DHS), April 1995 (1996 DHS), *September 2000* (2001-02 DHS) and January 2006 (2007 DHS).

4 National fertility estimates from 1950 to 2007

Tables in Appendix 1.a and 1.b present all national and provincial fertility estimates derived from the data sources described in the preceding section by mostly the Zambian Central Statistical Office (CSO). Table 1 presents the estimates the CSO selected as 'official' national fertility estimates for Zambia from 1950 to 2007.

Table 1 National total fertility estimates: Zambia, 1950-2007

Year	1950	1963	1969[1]	1980[2]	1990[3]	1992[4]	1996[4]	2000[5]	2001[4]	2007[4]
Estimate	5.7	6.7	7.1	7.2	6.7	6.5	6.1	6.0	5.9	6.2

Sources: Central Statistical Office and Demographic and Health Survey Reports.

Notes:
1. The 1969 Census official fertility estimates derived using the Brass P/F method based on corrected timescale error and age distribution.
2. The 1980 Census official fertility estimates derived using the Gompertz relational model with average age pattern of fertility schedules from from three models: The standard marital fertility schedule, Relational Gompertz model and the Coale-Trussel model fertility schedules.
3. The 1990 Census official fertility estimates derived using the Gompertz relational model.
4. Estimates derived from DHS data are for the three years preceding the survey.
5. The 2000 Census official fertility estimates derived using the Trussel Brass P/F Ratio method of estimating total fertility based on the average of P2/F2, P3/F3 and P4/F4.

*. Estimates derived from the remaining data sources are observed fertility rates i.e. not adjusted for underreporting.

Only crude estimates of fertility—that is, observed Crude Birth Rate (CBR), Child-Woman Ratio (CWR) and General Fertility Rate (GFR)—could be derived from the 1950-51 DSS and the 1963 Census because these sources did not have specific questions to measure fertility. To compare with standard fertility measures, we converted these crude fertility estimates to total fertility rates using the Bogue (1993) regression parameters. The converted total fertility estimates, however, could be imprecise because of the unconventional calculation of GFR and CWR by the CSO. For instance, the GFR—defined by the CSO as the average number of live births per

[9] Computed from the Century month codes variable

woman over puberty (Sheikh 1975: 2)—derived from the 1950-51 DSS data is age imprecise because "over puberty" implies women aged from 12 years and above *without an upper limit*. In addition, by definition, crude fertility measures—especially the Child-Woman Ratio (CWR)—suffer from unreliable age-sex distributions and omissions of children. Lastly, the Bogue parameters have an inherent drawback because they are based on regressions on actual data. Therefore, they only provide a rough estimate of total fertility (converted from a crude rate) because not all populations meet all the underlying assumptions of this change-over. Other formulas and coefficients for converting fertility—such as those described by Bogue, Arriaga and Anderton (1993) and Rele (1993)—require much more data than that provided by the 1950-51 DSS and the 1963 Census reports.

The CSO (1985a; 1985b) report that having identified critical errors in the 1980 Census data, they sought to analyse them critically when estimating fertility. Therefore, they applied almost all fertility estimation techniques available at the time to estimate fertility from the 1980 Census data (Appendix 1.a). However, the CSO do not state if they corrected the data for inaccurate and inconsistent reports before applying estimation techniques. The CSO (1985a; 1985b) report that omissions, misreporting and violation of assumptions—such as constant fertility in the recent past—affected the precision of almost all the estimates they calculated from the 1980 Census data. Specifically, the CSO (1985b) point out that inconsistencies between lifetime and current fertility affected estimates derived from the Brass P/F ratio and Arriaga methods while violation of assumptions affected the estimates they calculated from the stable population model. After examining estimates from all models, the CSO (1985b) selected fertility estimates they derived from the Relational Gompertz model as the most appropriate for Zambia in 1980 because—they suggest—this method violated the fewest assumptions. This is contrary to Cohen's (1993; 1998) report that the CSO applied the Brass P/F ratio method to derive the 1980 official fertility estimate. Similarly, Cohen (1993) reports that the CSO obtained a national total fertility estimate of 6.9 children per woman from the 1969 Census data after applying the Brass P/F ratio method. However, it is not possible to verify this figure and the reported method because efforts to find Cohen's source[10] have been unsuccessful.

[10]Central Statistical Office [Zambia]. 1985. *The 1980 Population and Housing Census of Zambia: Analytical Report Volume II: Fertility and Mortality Levels and Trends*. Lusaka: Central Statistical Office [Zambia].

Apart from the CSO, other researchers have estimated fertility from some of the sources described in the preceding section. In most cases, their fertility estimates are close to those reported by 'official' sources. Using a fertility schedule for Black Americans, Myburgh (1956) estimates total fertility for Zambia to be 5.9 children per woman from the 1950-51 DSS data. He notes that his estimate is inaccurate because of data problems, especially omission of children. Coale and Lorimer (1968) estimate Zambian total fertility of 6.6 children per woman from the 1963 Census data using a stable population model—that is West, female model: mortality level based on an assumed life expectancy at birth of 37.5 years (level eight). They state that their estimate is not reliable because they did not subject the data to detailed analysis and their assumptions are 'an informed guess'. Using the same data, Ohadike (1969) estimates a national CWR of 769 children (0-4.5 years) per 1000 women aged 15.5-45.5, which converts—using the Bogue (1993) regression parameters—to a total fertility rate of 5.8 children per woman. This estimate is different from the 1963 Census official estimate (Table 1) most certainly, because the authors used different age ranges which affects the crude measures they used to derive these estimates.

Table 2 presents national fertility estimates derived from the 1969 Census data as reported by various authors. It is difficult to comment further on cited estimates because we cannot find the original articles. Ohadike and Tesfaghiorghis (1975) report that after correcting the 1969 Census fertility data for obvious errors (without providing details of the errors); they obtained fertility estimates ranging from 6.7 to 6.9 children per woman. However, given the range of their estimates and those they have cited, Ohadike and Tesfaghiorghis (1975) propose the average—7.0 children per woman—as the best estimate of fertility in 1969. Lastly, Hill (1985) applies both the Brass P/F ratio method (comparing the number of women reporting a first-born child with proportion of mothers) as well as a stable population model to estimate fertility. She reports an estimate of 6.8 children per woman for both methods. However, in her later publication, (Hill 1990), she estimates national total fertility for the period 1965 to 1969 to be 7.0 children per woman (not presented in Table 2). Other than mentioning that she applied indirect techniques to age-specific fertility data, she does not state the method she used (Hill 1990: 23).

Table 2 National fertility estimates according to author and method: Zambia, 1969 Census

Author	Method	TFR
Coale and Page (1972)*	Not Stated	6.8
Okorakor and Ohadike (1973)*	Stable population model based on l_2 and c(15)	7.1
Okorakor and Ohadike (1973)*	Brass P/F Ratio method	7.4
Okorakor and Ohadike (1973)*	Stable population model based on C(x) and r	7.5
Ohadike and Tesfaghiorghis (1975)	Stable population model	6.7
Ohadike and Tesfaghiorghis (1975)	Based on child mortality l_2 and c(15)	6.9
Ohadike and Tesfaghiorghis (1975)	Reverse survival and Brass P/F ratio methods	6.9
Hill (1985)	Brass P/F Ratio method based on CEB and BLY first birth mothers	6.8
Hill (1985)	Stable population model	6.8

Note * cited in Ohadike and Tesfaghiorghis (1975).

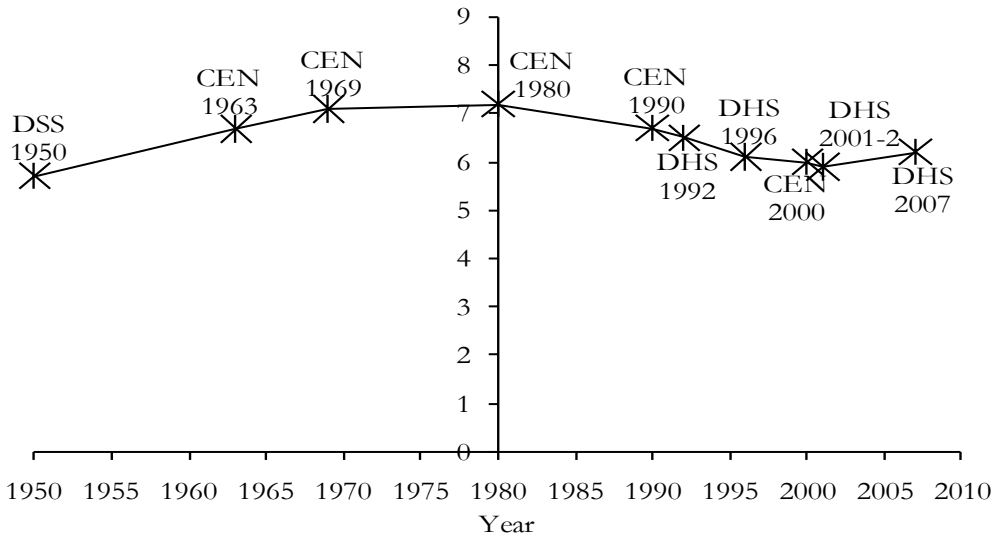
From the 1974 Sample Census fertility data, Hill (1990) estimates a national total fertility for the period 1970-1974 to be 7.0 children per woman. She does not provide details of the methods she used but suggests that fertility was constant between the late 1960s and early 1970s. Cohen (1993; 1998) reports applying the Coale method to the 1974 Sample Census fertility data and getting national total fertility estimates of 7.1 and 7.3 children per woman for 1967 and 1973, respectively. Other than these, there are no other published fertility estimates derived from the 1974 Sample Census. In one instance, however, Cohen (1993: 21; 1998: 1457) reports that Hill (1985) computed a total fertility estimate of 6.7 children per woman from the 1974 Sample Census data. Actually, Hill (1985: 48, 50) states that "total fertility could not be estimated because the 1974 Sample Census current fertility data were not available and an estimate based on the age distribution was not attempted because age data from this source was not reliable." When summarising, Hill (1985: 51) states that "an estimate of between 6.5 and 7.0 children per woman is based on the 1969 and 1974 Census data". It is possible that her summarising statement could be the source of Cohen's (1993; 1998) reporting oversight.

Lastly, using the 1980 Zambian Census data, Hill (1990) reports a national total fertility estimate of 6.8 children per woman for the period 1975 to 1979. Again, she does not specify the method she applied. Cohen (1993) applies the Coale method to the same data and gets a national total fertility estimate of 7.4 children per woman for 1973. There are no published fertility estimates based on data sources post the 1980 Census other than 'official' figures provided by the Zambian CSO.

5 National fertility trends

Figure 1 shows official national fertility trends from 1950 to 2007. We describe national and provincial fertility trends from official figures because estimates from researchers independent of government institutions are not available for any point after 1980. More importantly, apart from those derived from the 1963 Census data, official fertility estimates are similar to those computed by independent researchers. According to Figure 1, national fertility increased between 1950 and 1969 from 5.7 to 7.1 children per woman before levelling off between 1969 and 1980. Between 1980 and 2000, fertility declined gradually from 7.2 to 5.9 children per woman. After 2000, fertility has levelled off around 6.0 children per woman.

Figure 1 Official national total fertility estimates: Zambia, 1950- 2007



This trend conforms to Garenne's (2008: 4) observation that "…many sub-Saharan countries followed a typical pattern of a roughly constant, or modest increase in fertility before 1950; a substantial rise in fertility in the 1950s and 1960s; and then a decline …". He ascribes fertility increases in the 1950s to declines in sterility and infertility because of improvements in nutrition, hygiene and health. However, the apparent increase in Zambian national fertility before 1969 could also be a reflection of improvements in demographic data collection and fertility estimation. As stated earlier, it is almost certain that the 1950-51 Demographic Sample Survey and the 1963 Census underestimated fertility because of poor data and problems associated with crude estimates of fertility—such as unreliable age-sex population distributions—and probably the conversion of GFR and CWR to total fertility estimates using the Bogue (1993)

regression parameters. Hill (1985: 45) describes Zambian fertility data collected before 1969 as inadequate, unreliable and "… subject to some residual uncertainty".

6 Discussion

Overall, Zambian fertility is high and currently ranks second highest after the Democratic Republic of Congo among Southern African countries taking part in the DHS programme (Table 3). Further, its transition to low fertility has been sluggish. According to Kirk and Pillet's (1998) classification—that is, advanced, intermediate and delayed—Zambian fertility is either in the intermediate or delayed fertility transition stage. Some countries that had higher fertility than Zambia are now among the low fertility countries, for example, Kenya and Zimbabwe. In 1969 when Zambian fertility was 6.9 children per woman, Zimbabwe's total fertility was 8.3 children per woman (Cohen 1998; Kirk and Pillet 1998). During the same period, Kenya's total fertility was 7.6 children per woman before it rose to about eight children per woman. There is a need to examine "why Zambian fertility is high and its transition sluggish?"

Table 3 National fertility estimates of Southern African countries participating in the DHS programme—according to the latest available DHS reports

Country	Estimate	Survey
South Africa[1]	2.9	South Africa Demographic and Health Survey 1998
Lesotho	3.5	Lesotho Demographic and Health Survey 2004
Namibia	3.6	Namibia Demographic and Health Survey 2006-2007
Swaziland	3.8	Swaziland Demographic and Health Survey 2006-2007
Zimbabwe	3.8	Zimbabwe Demographic and Health Survey 2005-2006
Botswana	4.9	Botswana Family Health Survey 1988
Mozambique	5.5	Mozambique Demographic and Health Survey 2003
Tanzania[2]	5.6	Tanzania HIV/AIDS and Malaria Indicator Survey 2007-2008
Angola	5.8	Angola Malaria Indicator Survey 2006-2007
Malawi	6.0	Malawi Demographic and Health Survey 2004
Zambia[3]	6.2	Zambia Demographic and Health Survey 2007
Democratic Republic of Congo	6.3	Democratic Republic of Congo Demographic and Health Survey 2007

Sources: Demographic and Health Survey reports on these data sources

Notes: 1. The fertility estimates derived from 2003 South Africa DHS are not presented because the DHS reports that they are not plausible.

2. This estimate is the same as that observed in the 1999 Tanzania Reproductive and Child Health Survey and almost similar to that observ in the 2004-2005 Tanzania Demographic and Health Survey (5.7 births per woman).

3. This estimate indicates an increase in fertility from that observed in the 2001-2002 Zambia Demographic and Health Survey

Caldwell and Caldwell (2003) argue that, low levels of economic development translate into a slow transition from the unintended traditional fertility control to controlled fertility using modern contraception. Indeed, Zambia lacks a history of sustainable social and economic development beyond that which accompanied the mining industry in the late 1800s and early 1900s. If that pace of development had continued undisturbed beyond the 1970s, Zambia might have registered increasing

standards of living, improved infant survival, changing lifestyle and therefore significant mortality and fertility declines. However, Zambia's developmental progress disturbed by an increase in oil prices (Zambia's main import) in 1973 and a decline in copper prices (Zambia's main export) in 1974 (Government of the Republic of Zambia 1989). Structural adjustment programmes adopted to correct these problems slowed down employment creation, stagnated incomes and pushed the costs of health and education upwards. Zambia was also affected by the AIDS epidemic that halted mortality and hence fertility declines of most sub-Saharan African countries in the 1980s (Caldwell and Caldwell 2003). High fertility in Zambia could also be a case of poor family planning strategy. There is evidence that more Zambian women who wish to control fertility are not using contraception (Biddlecom and Kaona 2003).

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Appendix 1.a: National and provincial fertility estimates for Zambia from 1950 to 1980

Estimates derived from the 1950-1951 Demographic Sample Survey

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
GFR	182.0	158.0	162.0	171.0	na	na	257.0	na	184.0	136.0
TFR 1	5.7	5.0	5.1	5.4	na	na	8.0	na	5.8	4.3
TFR 2	7.9	6.9	7.1	7.5	na	na	11.2	na	8.0	6.0

Source: Central Statistical Office (1975)

Notes: 1. TFR 1: Converted from observed births per adult woman using the Bogue (1993) regression parameters
2. TFR 2: Converted from the national crude birth rate (56.8 births per 1000 population) using the Bogue (1993) regression parameters
3. Copperbelt was then called Western province and encompassed contemporary Luapula and North Western provinces
4. Western province was called Barotse province and Central province encompassed the contemporary Lusaka province
5. Statistics exclude a very small proportion of Africans living on non-African farms

Estimates derived from the 1963 Census

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
CWR	873.0	915.0	990.0	839.0	946.0	na	915.0	938.0	925.0	669.0
TFR 1	6.7	7.0	7.7	6.4	7.3	na	7.0	7.2	7.1	5.0
TFR 2	7.1	7.5	8.1	6.8	7.8	na	7.5	7.7	7.6	5.3

Source: Central Statistical Office (1975)

Notes 1. TFR 1: Converted from child-woman ratios using the Bogue (1993) regression parameters
2. TFR 2: Converted from crude birth rate using the Bogue (1993) regression parameters
3. Ratios based on children aged 0-4 and women aged 15-45.5 years
4. Central province encompassed the contemporary Lusaka province

Estimates derived from the 1969 Census data

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
Observed	4.0	4.8	5.4	3.2	5.2	na	6.1	3.0	4.2	1.9
Method 1	8.7	9.1	9.4	11.2	8.7	na	9.8	7.7	9.3	7.5
Method 2	7.4	7.6	8.5	8.5	6.8	na	8.3	6.1	7.8	5.2
Method 3	7.1	-	-	-	-	-	-	-	-	-

Source: Central Statistical Office (1973, 1985)

Notes: 1. The observed fertility estimates are obtained from the 1980 Census report because they were not presented by province in the 1973 Census Report.
2. Central province encompassed the contemporary Lusaka province.
3. Method 1: The CSO used the Brass and Coale (1968) method of estimating total fertility based on the age pattern of current fertility of all women of reproductive age and the level of the mean number of children ever born to young women.
4. Method 2: The CSO used the Brass and Coale (1968) method of estimating total fertility based on reported first births and the proportion of women who are mothers.
5. Method 3: The CSO used the Brass P/F method based on corrected timescale error and age distribution
6. The Central Statistical Office cautioned against comparing fertility estimates of other provinces with Eastern Province.

Estimates derived from the 1980 Census data

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
Observed	5.7	6.9	6.2	5.0	5.8	5.7	6.0	4.7	5.4	4.1
Method 1	8.4	8.3	9.2	7.1	9.3	8.4	8.4	8.9	9.1	6.6
Method 2	9.1	7.6	8.8	7.8	8.0		8.6	7.6	8.6	6.9
Method 3	9.7	9.7	9.6	8.9	9.9	9.8	9.7	8.6	9.9	7.8
Method 4	6.8	7.2	7.3	6.7	7.0	7.0	7.1	6.3	7.5	5.4
Method 5	7.6	7.3	7.7	7.0	7.1	7.7	7.6	6.9		5.9
Method 6	7.4	6.9	7.6	6.9	8.4	7.3	8.4	7.9	7.4	6.0
Method 7	7.4	-	-	-	-	-	-	-	-	-
Method 8	7.4	7.5	7.9	6.9	8.0	7.2	7.7	6.4	7.9	5.7
Method 9	7.2	7.5	7.9	6.9	8.0	7.5	7.7	6.5	7.1	5.7

Source: Central Statistical Office (1985)

Notes: 1. Method 1: Arriaga method: based on age specific fertility rates obtained from children ever born by age of mother
2. Method 2: Arriaga method: based on comparing ASFR obtained from above method with reported age pattern of fertility
3. Method 3: Brass P/F method: based on the age pattern of natural fertilityfertility
4. Method 4: Brass P/F method: based on marriage duration
5. Method 5: Brass P/F method: based on marriage duration and the age pattern of natural fertility
6. Method 6: United Nations (1967: 31-34): based on (P3)2/P2.
7. Method 7: Stable method: based on C(15) and average mortality level q(2), q(3) and q(5) for both sexes
8. Method 8: Relational Gompertz model: based on mean parities of young women aged (15-19), (20-24, and (25-29)
9. Method 9: Relational Gompertz model: based on the Gompertz relational model with average age pattern of fertility schedules from three models: The standard marital fertility schedule, Relational Gompertz model and the Coale-Trussel model fertility schedules
10. The Central Statistical office selected estimates computed from Method 9 as representative of Zambian fertility in 1980.

Appendix 1.b: National and provincial fertility estimates for Zambia from 1990 to 2007

Estimates derived from the 1990 Census

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
	6.7	6.3	6.6	6.9	7.2	6.0	7.5	6.9	7.0	6.2

Source: Central Statistical Office (1995)

Notes: 1. Reported observed total fertility for Zambia is 6.3
2. Method: Relational Gompertz model

Estimates derived from the 1992 and 1996 DHS

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
Method 1	6.5	6.8	6.2	6.8	7.4	5.5	7.4	6.0	7.1	6.0
Method 2	6.4	6.8	6.0	6.8	7.2	5.4	8.0	5.8	7.0	5.8

Source: The 1992 DHS report and Dzekedzeke and Nyangu (1994)

Notes: 1. Method 1: based on three-year duration and merged Central and Eastern/Luapula and Northern/Nwestern and Western Provinces, respectively
2. Method 2: based on four-year duration

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
	6.1	6.3	5.6	7.1	6.8	4.9	7.2	6.2	6.2	5.5

Source: The 1996 DHS report

Estimates derived from the 2000 Census

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
Method 1	6.0	6.2	5.2	6.6	7.0	4.6	6.9	6.3	6.3	5.8
Method 2	6.0	6.1	5.2	6.7	7.1	4.6	7.0	6.6	6.3	5.9

Source: Central Statistical Office (2003)

1. Method 1: Relational Gompertz method of estimating total fertility based on ASFR and CEB of age groups 20-34
2. Method 2: Trussel Brass P/F Ratio method of estimating total fertility based on (P2/F2: P3/F3 P4/F4)

Estimates derived from the 2001-02 and 2007 DHS

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
	5.9	6.2	4.5	6.8	7.3	4.3	6.9	6.8	6.1	6.4

Source: The 2001-02 DHS report

	Zambia	*Central*	*Copperbelt*	*Eastern*	*Luapula*	*Lusaka*	*Northern*	*NWestern*	*Southern*	*Western*
	6.2	6.4	4.8	7.1	7.2	4.1	7.9	7.3	6.7	6.2

Source: The 2007 DHS report